Electronic Supplementary Material (ESI) for Nanoscale.

Supplementary materials:

Electron Beam Induced Evolution in Au, Ag, and Interfaced Heterogeneous Au/Ag Nanoparticles

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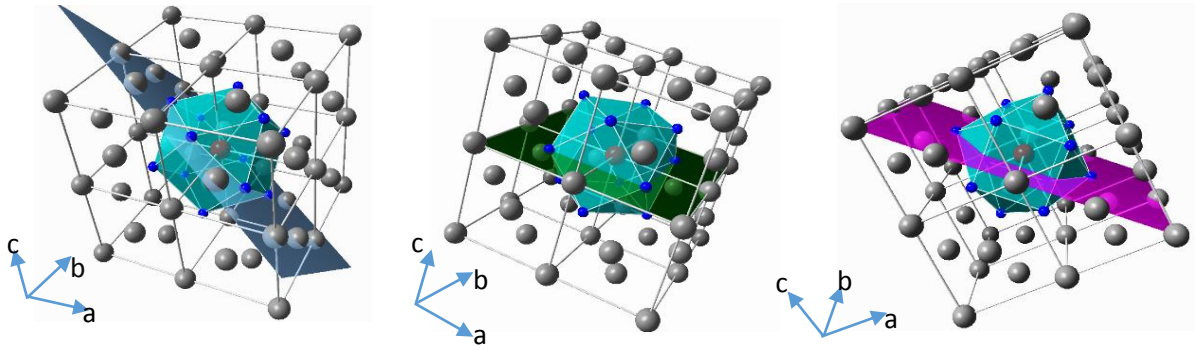

Figure S1. Schematic illustrations highlighting the lattice planes of (a) (111) (labeled in cyan), (b) (001) (labeled in dark green), and (c) (101) (labeled in purple) in a 2x2x2 crystalline face-centered cubic (FCC) lattice. The ligth blue polyhedrons highlight the nearest neighboring vertex atoms (blue) of an atom (at the center of each polyhedron) in the FCC lattice.

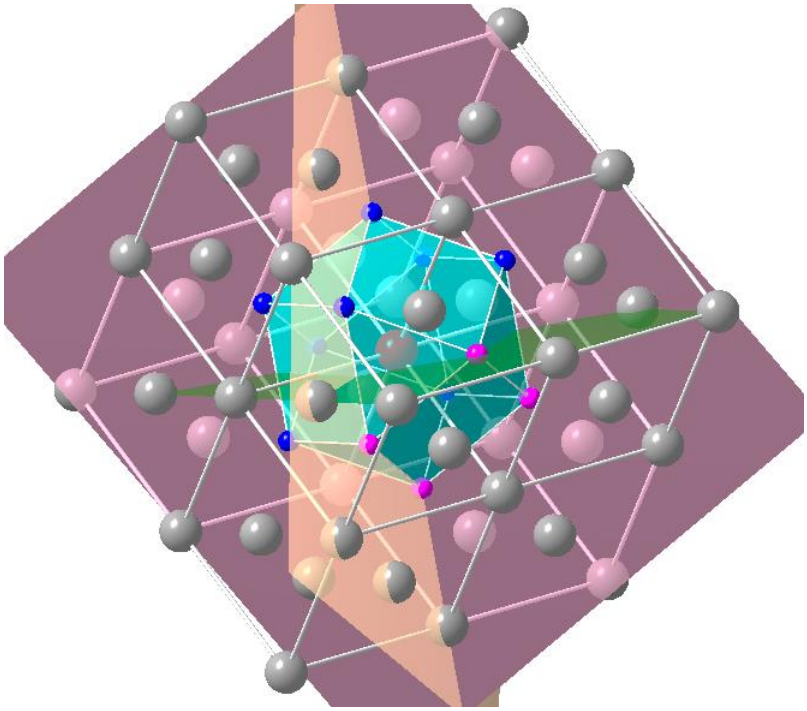

Figure S2. 4 nearest neighbors (purple) of the atoms at the corner of (111), (11-1) and (1-10). Other 8 nearest neighbor (blue) missed. This sample just shows that the corner atoms lose more nearest neighbors.

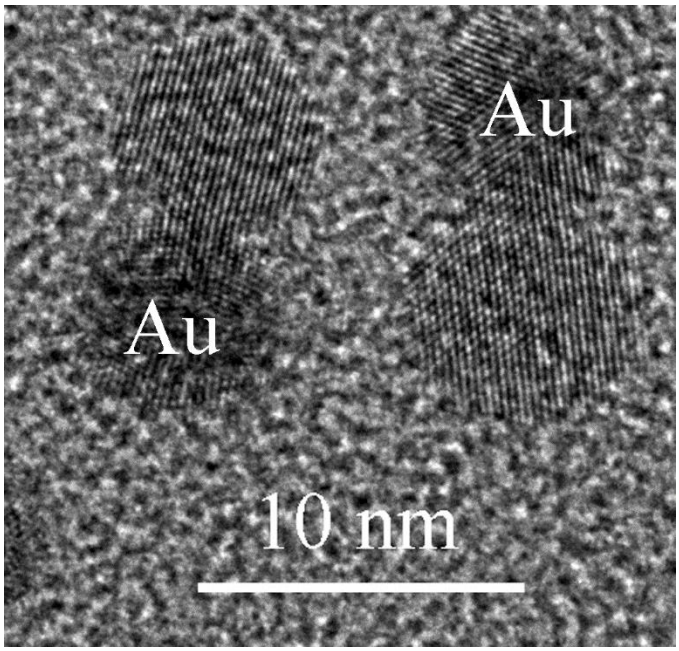

Figure S3. A typical HREM image showing the sharp interfaces and crystalline epitaxy between the Ag and Au domains in each interfaced Au/Ag dimers.

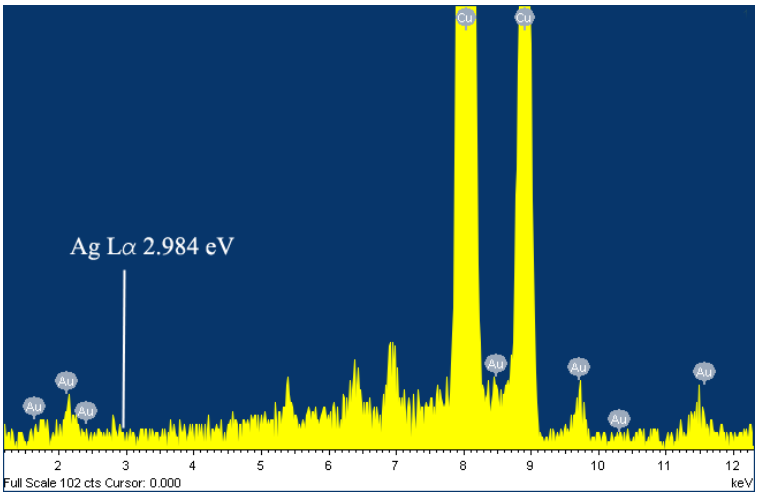

Figure S4. EDX spectrum taken from the nanoparticle shown in Figure 6d with a nanobeam in TEM. The spectrum exhibits strong signals of Au while no Ag signals can be observed, indicating that the Ag atoms have been completely sublimated from the Au@Ag core@shell particles shown in Figure 6c.

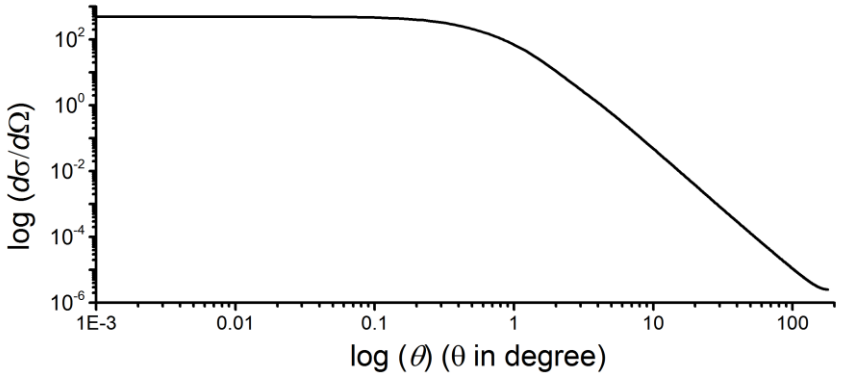

Figure S5. Simulated differential cross section (dσ/dΩ) as a function of scattering angle Θ.

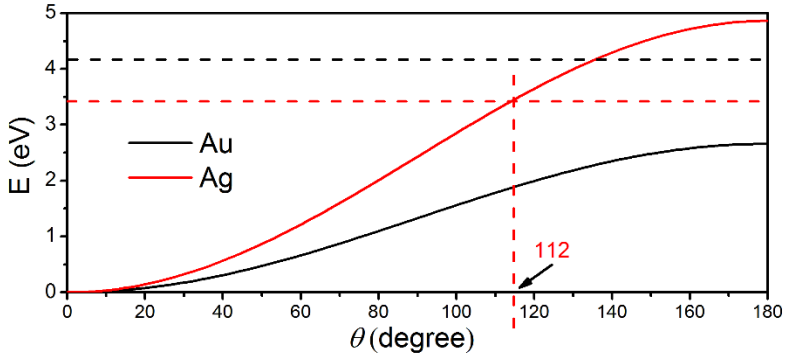

Figure S6 Efficiency for energy transfer from the 200-KeV electrons to Au (black) and Ag (red) as a function of scattering angle Θ. The dashed lines highlight whether the transferred energy can overcome the surface binding energy of Au (black) and Ag (red) to sublimate metal atoms.

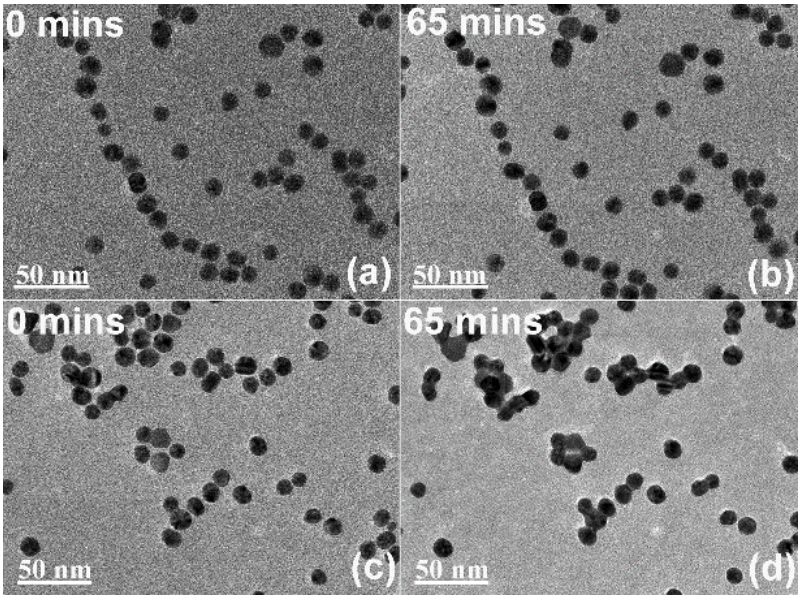

Figure S7. Bright-field TEM images of Au nanoparticles before (a, c) and after (b, d) illumination of electron beams with different beam intensities: (a, b) 1.5 pA/cm^2 and (c, d) 7.5 pA/cm^2.

Energy transfer from electron beam to atoms:

The energy transfer from electrons to atoms is governed by momentum conservation. The scattering angle dependence of the energy T transferred to the nucleus is given by[1]

$T(\Phi)=T_{max}\cos^2(\Phi)$ (S1)

Figure S8 illustrates the geometry of electron scattered by atom nucleus. At the scenario of head-on collision ($\Phi=0$), the transferred energy from electron to atom nucleus is maximum as [1-4]

$$E_{\max} = \frac{2M_A E_0 (E_0 + 2m_e c^2)}{(m_e + M_A)^2 c^2 + 2M_A E_0} \quad \text{(S2)}$$

Where M_A is the atom nucleus mass, m_e is the electron mass, c is Speed of light in vacuum, E_0 is the electron beam energy.

It should be mentioned here, the electron must be treated as relativistic particle since its velocity is about 0.7c.

Because $M_A/m_e=1823\ Z >>1$ and $E_0<<M_Ac^2$, where Z is the atomic mass number.

$$E_{\max} = \frac{2E_0 (E_0 + 2m_e c^2)}{M_A c^2} \quad \text{(S3)}$$

$$E_{\max} = \frac{E_0 (1.02 + E_0 / 10^6)}{465.7Z} \quad \text{(S4)}$$

From equation S3, we can see that the maximum transferred energy is only inversely proportional to its atomic mass number if the electron beam energy is constant. (in our experiment, E_0=200keV)

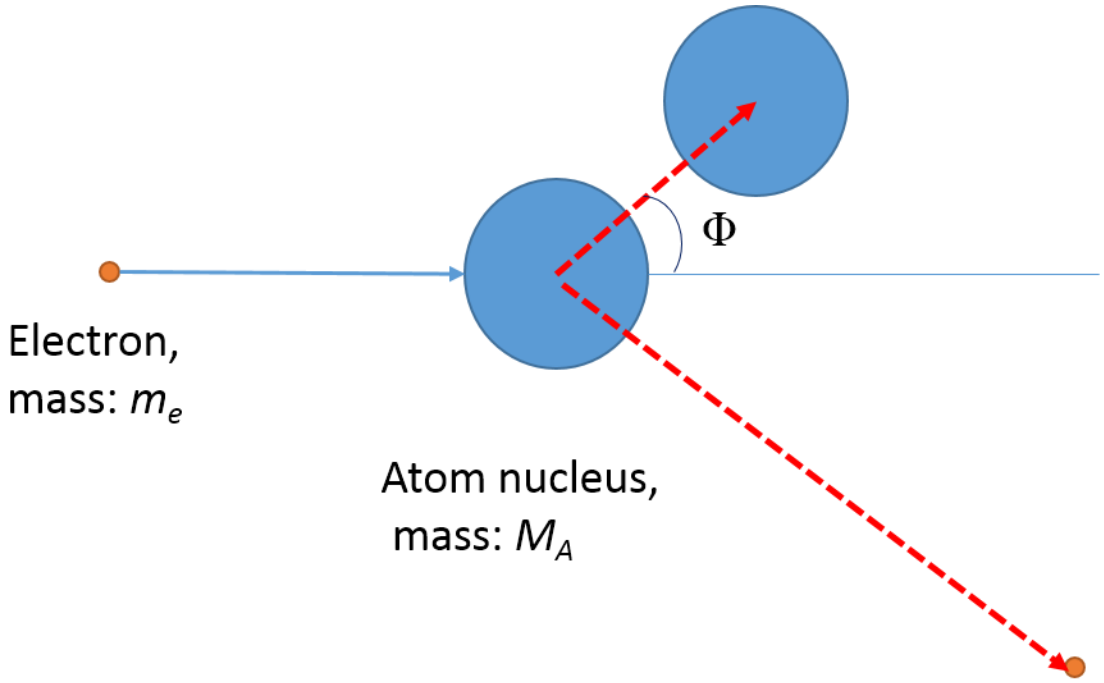

Figure S8 The diagram shows the scattering of electron by atom nucleus.

1. Vajda, P., Anisotropy of electron radiation damage in metal crystals. *Rev. Mod. Phys.* **1977,** *49* (3), 481-521.
2. Banhart, F., Irradiation effects in carbon nanostructures. *Rep. Prog. Phys.* **1999,** *62* (8), 1181.
3. Egerton, R. F.; McLeod, R.; Wang, F.; Malac, M., Basic questions related to electron-induced sputtering in the TEM. *Ultramicroscopy* **2010,** *110* (8), 991-997.
4. Egerton, R. F.; Li, P.; Malac, M., Radiation damage in the TEM and SEM. *Micron* **2004,** *35* (6), 399-409.